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Records of terricolous lichens from páramos of southern Ecuador

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Abstract—Ecological studies of five páramos in Azuay and Loja provinces recorded one lichen species new to South America (*Bryoria nitidula*), five new to Ecuador (*Cladonia halei, C. melanopoda, C. merochlorophaea, C. subreticulata, Diploschistes diacapsis*), two new to mainland Ecuador (*Cladonia grayi, C. pyxidata*), and 20 new provincial records. Brief morphological descriptions, with remarks on distribution and ecology, are provided.

Key words—Andes, biodiversity, *Cladoniaceae,* Neotropics

Introduction

The páramo is a Neotropical ecosystem located between the upper forest line and the permanent snow line. In southern Ecuador these ecosystems are found from 2800 m altitude, due to local factors such as climate, soil, and the degree of human intervention (León-Yánez 2000, Medina & Mena 2001).

The páramo flora is extremely diverse and considered the richest high mountain flora of the world (Smith & Cleef 1988, Luteyn 1999). Unfortunately, its lichen communities are relatively poorly studied (Sipman 2002a). Within the relevant published information we should emphasize the studies by Sipman (1992, 1999, 2005), which reported a total of 463 lichen species for Neotropical páramos (264 species from Colombia, 204 from Costa Rica, and 191 from

Ecuador). Also, in monographs on *Cladoniaceae* (Ahti 1992, 2000), 50 species of this family were reported from the Andean páramos and subpáramos from Costa Rica to Bolivia, 39 of them above 2800 m in páramo ecosystems in Ecuador.

Despite these previous studies, the lichen biota of Neotropical páramos still deserves further study, since the detailed distributions of these taxa are not well known (Ahti 1992, Sipman 2002a) and lichen flora in Ecuador has been poorly studied in general (Lücking 1999, Nöske & Sipman 2004, Paredes 2006). Our ongoing studies of the Ecuadorian lichen biota have compiled ca. 900 lichen species for mainland Ecuador (Cevallos 2012); comparison with the ca. 800 species reported from the Galapagos Islands (Bungartz et al. 2013) and the estimate of 2700 species for Ecuador (Lücking et al. 2009) underscores the need for further research on lichen flora in Ecuador.

Thus our goal is to contribute to the knowledge of the lichen flora in páramo ecosystems and in Ecuador overall.

Material & methods

The specimens were collected in five páramos in Loja and Azuay provinces, southern Ecuador: Cajanuma, El Cajas, Jimbura, Loma del Oro, and Punzara, located at altitudes between 2770 and 4040 m. The samples were collected during ecological studies carried out in 2010 and 2014 (González et al. 2017). Dried specimens were morphologically and anatomically examined using a stereomicroscope and compound microscope. For species identification we followed Lumbsch (1989), Ahti (2000), Brodo et al. (2001), Smith et al. (2009), and Rivas Plata et al. (2010). Secondary compounds were detected by spot tests and thin-layer chromatography (TLC). Specimen dimensions and chemotype nomenclature follow Ahti (2000). The specimens are stored in the Herbarium of Universidad Técnica Particular de Loja, Loja, Ecuador (H-UTPL).

Results

We identified one species new to South America (marked ***), five new to Ecuador (marked **), two new to mainland Ecuador (marked *), and 20 new provincial records.

Alectoria ochroleuca (Hoffm.) A. Massal., Sched. Critic. 2: 47. 1855.

Spot test: cortex KC+ yellow, PD–; medulla KC+ yellow or KC–, CK+ yellow-gold, PD–.

Specimens examined—**ECUADOR**, **Azuay**. **Cuenca:** Parque Nacional El Cajas, 2°46′53″S 79°13′21″W, 3930 m, páramo, 27.7.2010, A. Benítez, Y. González & M. Prieto (H-UTPL YG-0060); 2°46′47″S 79°12′20″W, 3788 m, 13.3.2014, A. Benítez & Y.

González (H-UTPL YG-0303); 2°47′39″S 79°12′09″W, 3894 m, 26.3.2014 (H-UTPL YG-0304); 2°47′03″S 79°13′30″W, 4009 m, 15.2.2014 (H-UTPL YG-0305).

Alectoria ochroleuca is characterized by its erect to decumbent shrubby thallus with greenish yellow branches darkening towards the tips (Brodo et al. 2001).

Widespread in Asia, Central and North America, Europe, and Oceania (Guzmán-Dávalos & Álvarez 1987, Smith et al. 2009), in South America *A. ochroleuca* is distributed in Argentina, Bolivia, Chile, Colombia, Costa Rica, Ecuador, Peru, and Venezuela (Nylander 1861, Galloway & Quilhot 1998, Calvelo & Liberatore 2002, Umaña-Tenorio et al. 2002, Sipman 1999, Ramos 2014).

This species grows on the ground or rarely on shrubs and preferably in arctic-alpine ecosystems (Brodo et al. 2001). In Ecuador, it was previously cited in Chimborazo, Cotopaxi, Loja, and Pichincha provinces (Zahlbruckner 1905, 1907; Arvidsson 1991; Sklenář et al. 2010; Benítez et al. 2012). Here it is reported for the first time from Azuay province (in El Cajas páramo).

Arthrorhaphis alpina (Schaer.) R. Sant., Lichenologist 12: 106. 1980.

Specimens examined—**ECUADOR**, **Loja**. **Loja:** Punzara, 4°02′36″S 79°13′59″W, 2770 m, páramo, 19.7.2010, A. Benítez, Y. González & M. Prieto (H-UTPL YG-0105); **Saraguro:** Loma del Oro, 3°40′52″S 79°14′24″W, 3245 m, páramo, 19.8.2010, A. Benítez, Y. González & M. Prieto (H-UTPL YG-0106).

The thallus of *A. alpina* is composed of more or less rounded, convex, bullate squamules, ≤1 mm diam., yellow to yellowish green, matte, and with a more or less pruinose roughened surface. Apothecia are infrequent, located between the squamules, blackish grey-green.

Arthrorhaphis alpina is widespread in Asia, Europe, North America, and Oceania (Obermayer 1994, Esslinger & Egan 1995, Elix & McCarthy 1998, Aptroot & Feijen 2002, Aptroot & Sparrius 2003). In South America is distributed in Bolivia, Colombia, Chile, Costa Rica, Ecuador, and Venezuela (Hafellner & Obermayer 1995, Sipman 1999, Galloway & Quilhot 1998). The species grows on soil and among mosses (Smith et al. 2009).

Previously found in Ecuador in Pichincha province (Arvidsson 1991), this is the first record of *A. alpina* for Loja province.

Bryoria nitidula*** (Th. Fr.) Brodo & D. Hawksw., Op. Bot. 42: 107. 1977. Fig. 1

Fruticose, shrubby thallus, 4–8 cm, erect or spreading horizontally over the ground, branching anisotomic and usually dichotomous towards the apices. Branches dark brown to black, darker at the base, shiny and terete, 0.5–0.9 mm diam., with a few lateral perforations or fissures of 0.4–0.8 mm; lacking soredia or isidia.

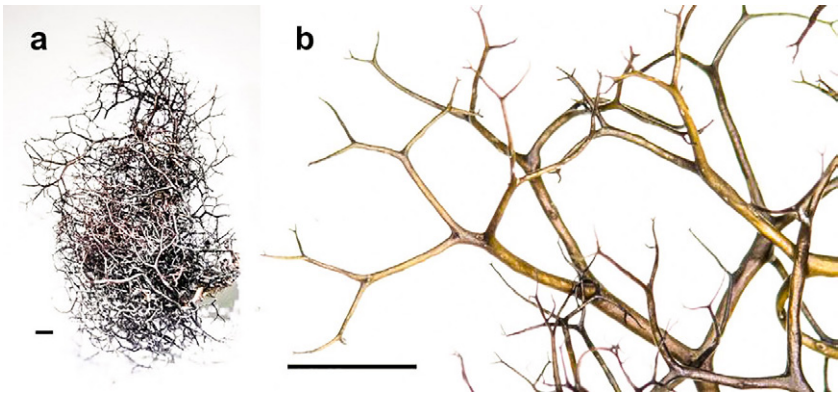

Figure 1. ***Bryoria nitidula.***
a. Thallus. b. Branching of podetia. Scale bars: a = 5 mm; b = 2 mm.

Substances detected by TLC: none.

Specimens examined—**ECUADOR**, **Azuay**. **Cuenca:** Parque Nacional El Cajas, 2°46′53″S 79°13′21″W, 3930 m, páramo, 27.7.2010, A. Benítez, Y. González & M. Prieto (H-UTPL YG-0057); 2°47′39″S 79°12′09″W, 3890 m, 26.3.2014, A. Benítez & Y. González (H-UTPL YG-00301); 2°46′47″S 79°12′21″W, 3789 m, 13.3.2014 (H-UTPL YG-00298).

Bryoria nitidula occurs in Asia, Europe, and North America, growing on arctic and subarctic heaths (Smith et al. 2009). It was found for the first time in Ecuador being locally common in El Cajas páramo, at 3750–4020 m elevations. This is the first record in South America.

Our specimens closely resemble those described from North America, but the Ecuadorian samples do not contain fumarprotocetraric acid.

Cladia aggregata (Sw.) Nyl., Bull. Soc. Linn. Normandie, Ser. 2, 4: 167. 1870.

Substances detected by TLC: barbatic and 4-O-demethylbarbatic acids (chemotype I).

Specimens examined—**ECUADOR**, **Loja**. **Loja:** Parque Nacional Podocarpus, Cajanuma, 4°06′59″S 79°09′41″W, 3337 m, páramo, 29.6.2010, A. Benítez, Y. González & M. Prieto (H-UTPL YG-0064); 13.7.2010 (H-UTPL YG-0079); Punzara, 4°02′36″S 79°13′59″W, 2770 m, páramo, 19.7.2010, A. Benítez, Y. González & M. Prieto (H-UTPL YG-0100); **Saraguro:** Loma del Oro, 3°40′52″S 79°14′24″W, 3245 m, páramo, 19.8.2010, A. Benítez, Y. González & M. Prieto (H-UTPL YG-0005 and H-UTPL YG-0006); **Espíndola:** Jimbura, 4°42′37″S 79°25′46″W, 3450 m, páramo, 8.7.2010, A. Benítez, Y. González & M. Prieto (H-UTPL YG-0082 and H-UTPL YG-0083).

The thallus of *C. aggregata* is characterized by its dark brown to blackish, pale yellowish to straw-colored or pale green pseudopodetia, 5–150 × 0.5–8 mm.

The pseudopodetial wall is cartilaginous with infrequent to abundant rounded to elliptic perforations; the central canal surface is white and loosely arachnoid (Ahti 2000).

Although several species have been described with the same chemosyndrome within the *Cladia aggregata* complex (Parnmen et al. 2012, 2013), their distribution and morphology do not match our samples. Moreover, the barcoding molecular sequences produced for our samples (nuITS region) place our samples with *Cladia aggregata* s. str.

Cladia aggregata s. lat. is distributed in the Southern Hemisphere, including Australasia, Southeast Asia to South Japan and India, and South Africa (Ahti 2000). In the Neotropical region it is widespread, from Mexico and the West Indies to the subantarctic islands, but it is absent in lowland and arid regions (Ahti 2000). It is very common in montane areas, on soil, and wood (Ahti 2000). In Ecuador four chemotypes (II, III, IV, and VII) have previously been reported (Ahti 2000). Chemotype I was found for the first time in mainland Ecuador growing in páramos of Azuay and Loja provinces. This chemotype was previously reported in Galapagos Islands (Yánez-Ayabaca et al. 2013). Our specimens constitute the first records from Loja province.

Cladia fuliginosa Filson, Victorian Nat. 87: 325. 1970

Substances detected by TLC: divaricatic and usnic acids.

Specimens examined—**ECUADOR**, **Loja**. **Loja:** Parque Nacional Podocarpus, Cajanuma, 4°06′59″S 79°09′41″W, 3337 m, páramo, 29.6.2010, A. Benítez, Y. González & M. Prieto (H-UTPL YG-0081); Punzara, 4°02′36″S 79°13′59″W, 2770 m, páramo, 19.7.2010, A. Benítez, Y. González & M. Prieto (H-UTPL YG-0098 and H-UTPL YG-0099); **Saraguro:** Loma del Oro, 3°40′52″S 79°14′24″W, 3245 m, páramo, 7.7.2010, A. Benítez, Y. González & M. Prieto (H-UTPL YG-0001 and H-UTPL YG-0002); **Espíndola:** Jimbura, 4°42′37″S 79°25′46″W, 3450 m, páramo, 8.7.2010, A. Benítez, Y. González & M. Prieto (H-UTPL YG-0091).

Cladia fuliginosa produces green to blackish brown pseudopodetia, ≤70 × 2 mm; the perforated and irregularly branched pseudopodetia are mostly filled by a dark brown to black inner medulla (Ahti 2000).

Distributed throughout the Andes, from Colombia to Peru growing on soil in páramos, *C. fuliginosa* is also present in Australia and New Zealand (Ahti 2000). In Ecuador, it has previously been cited in Azuay, Imbabura, and Pichincha provinces (Arvidsson 1991, Ahti 2000). Our collections constitute the first records of *C. fuliginosa* from Loja province.

Cladonia aleuropoda Vain., Beibl. Hedwigia 38: 190. 1899.

Substances detected by TLC: fumarprotocetraric and often quaesitic acids (chemotype I) and grayanic acid (chemotype II).

Specimen examined—**ECUADOR**, **Loja**. **Loja:** Punzara, 4°02′36″S 79°13′59″W, 2770 m, páramo, 19.7.2010, A. Benítez, Y. González & M. Prieto (H-UTPLYG-0104).

The thallus produces 3–10 cm tall unbranched or sparsely branched whitish to brownish gray podetia. Initially subulate, the podetial tips later produce 1–7 mm wide scyphi (Ahti 2000).

Cladonia aleuropoda is distributed at 2200–4500 m elevations along the Andes in Colombia, Costa Rica, Ecuador, Guatemala, México, Peru, and Venezuela, growing on soil and rocks in páramos and upper cloud forests (Ahti 2000). Chemotypes I and II have been previously recorded in Ecuador from Azuay, Carchi, Chimborazo, Cotopaxi, Napo, and Pichincha provinces (Ahti 2000). This is the first record of chemotype I for Loja province.

Cladonia arbuscula (Wallr.) Flot., Thermen Warmbr. Riesengeb.: 94. 1839, s.lat.

Substances detected by TLC: fumarprotocetraric and usnic acids (chemotype I).

Specimens examined—**ECUADOR**, **Azuay**. **Cuenca:** Parque Nacional El Cajas, 2°46′53″S 79°13′21″W, 3930 m, páramo, 27.7.2010, A. Benítez, Y. González & M. Prieto (H-UTPL YG-0041); 2°46′60″S 79°13′61″W, 4012 m, 22.2.2014 (H-UTPL YG-0275); 2°47′40″S 79°12′08″W, 3893 m (H-UTPL YG-0278); 2°47′39″S 79°12′09″W, 3891 m, 26.3.2014 (H-UTPL YG-0274); 2°46′47″S 79°12′19″W, 3789 m, 14.3.2014 (H-UTPL YG-0276); 2°46′50″S 79°12′20″W, 3787 m, 13.3.2014 (H-UTPL YG-0273). **Loja**. **Saraguro:** Loma del Oro, 3°40′52″S 79°14′24″W, 3245 m, páramo, 19.8.2010, A. Benítez, Y. González & M. Prieto (H-UTPL YG-0037); **Espíndola**: Jimbura, 4°42′37″S 79°25′46″W, 3450 m, páramo, 8.7.2010, A. Benítez, Y. González & M. Prieto (H-UTPL YG-0092).

Under *C. arbuscula,* we include specimens representing the type subspecies and the subspecies *boliviana*. Piercey-Normore et al. (2010), who demonstrated that molecular data do not support the existence of some subspecies, did not include subsp. *boliviana*, and so additional molecular analyses are needed to test the status of subsp. *boliviana*.

C. arbuscula subsp. *boliviana* (Ahti) Ahti & DePriest is characterized by yellowish to whitish gray podetia with slightly brownish tips. It grows up to 17 cm, its podetia are slender, generally loosely branched, with its ultimate branchlets erect to divaricate, rather dense at apex but rarely strongly unilaterally deflexed (Ahti 2000). The subspecies differs from *C.* subsp. *arbuscula* mainly in its darker color, bigger size, and highly frequent dichotomous branching, and the absence of psoromic acid (Ahti 2000). However, these characters could be misleading and molecular data are necessary for the identification of the Andean material (Ahti pers. comm.).

Cladonia arbuscula is common in páramos and upper Andean forests (Ahti 2000) in Bolivia (chemotype I), Brazil (I, II), Colombia (I, II, III), and Venezuela (I, II, III) but rare in Costa Rica (II) and Guatemala (I). In Ecuador chemotype

II (with usnic acid only) has been previously found in the provinces of Azuay, Galapagos Islands, Imbabura, Loja, and Tungurahua (Ahti 2000). Chemotype I was found for the first time in Ecuador, growing in three different páramos.

Cladonia coccifera (L.) Willd., Fl. Berol. Prodr.: 361. 1787.

Substances detected by TLC: zeorin and usnic acid.

Specimens examined—**ECUADOR**, **Azuay**. **Cuenca:** Parque Nacional El Cajas, 2°46′53″S 79°13′21″W, 3930 m, páramo, 27.7.2010, A. Benítez, Y. González & M. Prieto (H-UTPL YG-0052 and H-UTPL YG-0053); 2°46′46″S 79°12′20″W, 3786 m, 13.3.2014, A. Benítez & Y. González (H-UTPL YG-0160).

Cladonia coccifera is characterized by its persistent primary thallus, consisting of ascending squamules, often with orange basal parts. The 0.7–3.5 cm tall podetia are greenish, yellowish or whitish gray, with an areolate-corticate surface and totally covered by pruinose granules, schizidia, and phyllidia (also inside the scyphi). Red-coloured hymenial discs are fairly common (Ahti 2000).

Distributed in the Northern Hemisphere in Himalaya, Java, and Papua New Guinea, *C. coccifera* has been found at elevations of 2400–4300 m throughout Central and South America in Argentina, Bolivia, Brazil, Colombia, Costa Rica, Ecuador, Guatemala, Hispaniola, Venezuela, and Peru (Sipman 1999, Ahti 2000, Calvelo & Liberatore 2002, Flakus et al. 2008), growing on humous soils and occasionally on wood and plant debris. Previously reported for Ecuador in Carchi, Cotopaxi, Loja, and Zamora-Chinchipe (Ahti 2000, Nöske & Sipman 2004, Mandl 2007), this is the first record of *C. coccifera* for Azuay province.

Cladonia corniculata Ahti & Kashiw., Stud. Cryptog. South. Chile: 136. 1984.

Substances detected by TLC: fumarprotocetraric acid.

Specimens examined—**ECUADOR**, **Loja**. **Saraguro:** Loma del Oro, 3°40′52″S 79°14′24″W, 3245 m, páramo, 19.8.2010, A. Benítez, Y. González & M. Prieto (H-UTPL YG-0028); **Loja:** Parque Nacional Podocarpus, Cajanuma, 4°06′59″S 79°09′41″W, 3337 m, páramo, 13.7.2010, A. Benítez, Y. González & M. Prieto (H-UTPL YG-0067, H-UTPL YG-0068, H-UTPL YG-0069 and H-UTPL YG-0080).

Cladonia corniculata is characterized by 12–60 × 0.5–2.5 mm white, green, or whitish gray podetia. Podetia are flexuous or not, at first unbranched and later dichotomously branched, with subulate tips, always ascyphose, sometimes with obtuse or dilated branchlets. Thallus surface is completely ecorticate with farinose to slightly granulose soredia (Ahti 2000).

Distributed throughout Asia, Africa, Australia, New Zealand, and the subantarctic islands, *C. corniculata* is widespread in Central and South America (especially at high elevations in the Andes). It grows on moist and shady road banks in páramos being rare on bare soils (Stenroos et al. 1992, Ahti 2000).

In Ecuador the species was previously reported from Azuay, Carchi, Cotopaxi, Galapagos Islands, Imbabura, Napo, and Pichincha (Ahti 2000); our collections represent the first records for Loja province.

Cladonia crispata (Ach.) Flot., Thermen Warmbr. Riesengeb.: 93. 1839.

Substances detected by TLC: squamatic acid.

Specimen examined—**ECUADOR**, **Loja**. Loja: Punzara, 4°02′36″S 79°13′59″W, 2770 m, páramo, 19.7.2010, A. Benítez, Y. González & M. Prieto (H-UTPL YG-0097).

The thallus of *C. crispata* is characterized by its 20–80 × 0.5–2 mm brownish gray podetia that are not blackish at the base. The podetia have dilated apices, 1–3 mm wide axillary funnels, and a smooth surface (Ahti 2000).

A subcosmopolitan species, distributed throughout Australasia, East Africa, Asia, Europe, New Guinea, and North America (Ahti 2000, Burgaz & Ahti 2009), *C. crispata* has been recorded throughout Central and South America in Colombia, Costa Rica, Dominican Republic, Ecuador, Jamaica, Peru, and Venezuela (Ahti 2000) as locally common in páramos and upper Andean forests where it grows on soil and wood at 1700–3300 m altitudes (Ahti 2000). Previously recorded in Ecuador from Zamora-Chinchipe (Nöske & Sipman 2004) in upper montane forests, our first collection in páramo in Loja province widens the distribution and ecology of *Cladonia crispata* in Ecuador.

Cladonia grayi* G. Merr. ex Sandst., Sandstede Clad. Exs.: no. 1847. 1929. Fig. 2

Podetia 1–2 cm, scyphose, greenish gray, often brownish in basal parts, with proliferations from scyphal margins, scyphi 2–4.5 mm diam. Surface rough, verruculose, upper part and interior of scyphi granulose, clearly sorediate or eroded in some parts, with age developing macrosquamules. Hymenial discs frequent, dark brown.

Substances detected by TLC: fumarprotocetraric and grayanic acids.

Specimen examined—**ECUADOR**, **Azuay**. Cuenca: Parque Nacional El Cajas, 2°46′47″S 79°14′57″W, 3789 m, páramo, 13.3.2014, A. Benítez & Y. González (H-UTPL YG-0165).

Cladonia grayi, widespread in the Northern Hemisphere from the Arctic to temperate regions (where it is very common in eastern North America) and is also present in Australasia (Ahti 2000, Burgaz & Ahti 2009). In the Neotropical region it is scattered throughout Argentina, Bolivia, Brazil, Colombia, Costa Rica, Cuba, Dominican Republic, El Salvador, Galapagos Islands, Guatemala, Haiti, Honduras, Jamaica, Paraguay, Uruguay, and Venezuela, growing at high elevations on highly acidic soils (Ahti 2000, Burgaz & Ahti 2009, Yánez-Ayabaca et al. 2013). Our collection from one locality in Azuay province represents a first record of *C. grayi* from mainland Ecuador.

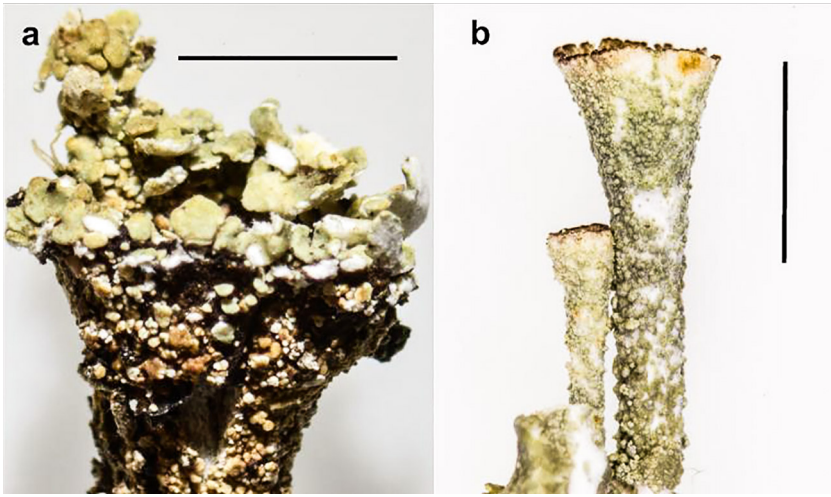

Figure 2. ***Cladonia grayi.*** a. Macrosquamules on margin of scyphi. b. Granules on upper part of scyphi. Scale bars: a = 3 mm; b = 2 mm.

Although similar to specimens described for the Neotropical and temperate regions (Ahti 2000), our Ecuadorian material is does not develop macrosquamules at the base and is found at higher altitudes (3789 m).

Cladonia halei** (Ahti) Ahti & DePriest, Mycotaxon 78: 501. 2001. Fig. 3

Podetia ash gray or brownish gray, darkening when exposed. Thallus ≤12 cm tall, with anisotomic branches, usually deflexed, with clearly distinct 0.6–2 mm thick main axis. Podetia surface markedly verruculose with arachnoid interspaces.

Substances detected by TLC: fumarprotocetraric acid.

Specimens examined—**ECUADOR**, **Azuay**. **Cuenca:** Parque Nacional El Cajas, 2°46′53″S 79°13′21″W, 3930 m, páramo, 27.7.2010, A. Benítez, Y. González & M. Prieto (H-UTPL YG-0050 and H-UTPL YG-0051); 2°47′08″S 79°13′32″W, 4032 m, 8.2.2014, A. Benítez & Y. González (H-UTPL YG-0299); 2°47′38″S 79°12′09″W, 3884 m, 25.3.2014 (H-UTPL YG-0286); 2°46′46″S 79°12′20″W, 3788 m, 13.3.2014 (H-UTPL YG-0300).

Cladonia halei has been previously recorded in Colombia, Papua New Guinea, Peru, and Venezuela (Ahti 2000 and pers. comm.), growing in páramo and subpáramo zones at 2500–4000 m altitudes in wet *Sphagnum* bogs and on drier ground in humid montane regions (Ahti 2000). Our discovery of *C. halei* for the first time in Ecuador growing in El Cajas páramo considerably widens its world distribution.

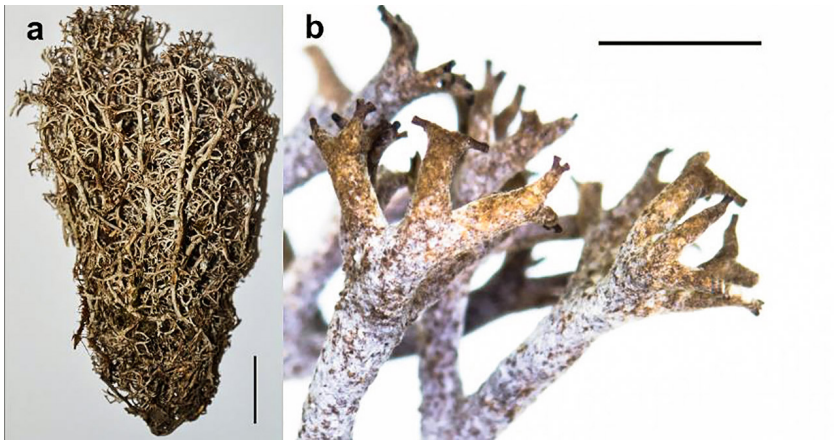

Figure 3. ***Cladonia halei.***
a. Thallus. b. Branching of podetia. Scale bars = 5 mm.

Our specimens are similar in morphology, chemistry, and ecology to that described for the Neotropical region.

Cladonia leprocephala Ahti & S. Stenroos, Ann. Bot. Fenn. 23: 236. 1986.

Substances detected by TLC: thamnolic acid.

Specimens examined—**ECUADOR**, **Azuay**. **Cuenca:** Parque Nacional El Cajas, 2°46′53″S 79°13′21″W, 3930 m, páramo, 27.7.2010, A. Benítez, Y. González & M. Prieto (H-UTPL YG-0046); 2°47′37″S 79°12′09″W, 3891 m, 25.3.2014, A. Benítez & Y. González (H-UTPL YG-0166).

Cladonia leprocephala is characterized by its 8–23 × 0.8–2 mm greenish to whitish gray podetia with scyphi having subentire margins 2–3 mm wide. Thallus surface in generally basally areolate-corticate up to the scyphi, with granulose soredia. The red hymenial discs are rare and present at the tips of proliferations from scyphal margins (Ahti 2000).

Distributed along the Andes in Colombia, Costa Rica, Ecuador, Peru, and Venezuela in páramos at 2900–4250 m elevations, growing on moist and humous soils, on wood, and as epiphyte on shrubs at timberline (Ahti 2000, pers. comm.), in Ecuador *C. leprocephala* has been previously reported from Cotopaxi, Napo, Pichincha, and Tungurahua (Ahti 2000). Our collections represent the first records of the species for Azuay province.

Cladonia lopezii S. Stenroos, Ann. Bot. Fenn. 26: 250. 1989.

Substances detected by TLC: didymic acid.

Specimen examined—**ECUADOR**, **Azuay**. **Cuenca:** Parque Nacional El Cajas, 2°46′53″S 79°13′21″W, 3930 m, páramo, 27.7.2010, A. Benítez, Y. González & M. Prieto (H-UTPL YG-0106).

The species has ≤25 × 30 mm brown podetia that are marginal on primary squamules, which elongate and roll up to form the podetial tube, abruptly flaring to form conspicuously dorsiventrally flattened web-like structures. The podetia usually produce red hymenial discs, forming agglomerations up to 9 mm wide (Ahti 2000).

Cladonia lopezii occurs in the high Andes from Bolivia to Venezuela and in Brazil at 1200–3935 m altitudes, growing on soil, rocks, and rotten wood (Ahti 2000). The species has been previously found in Loja, Morona-Santiago, and Zamora-Chinchipe (Ahti 2000, Nöske & Sipman 2004, Mandl 2007); our collection constitutes the first record for Azuay province.

Cladonia macilenta Hoffm., Deutschl. Fl. 2: 126. 1796.

Substances detected by TLC: barbatic acid [chemotype II].

Specimen examined—**ECUADOR**, **Azuay**. **Cuenca:** Parque Nacional El Cajas, 2°46′46″S 79°12′18″W, 3793 m, páramo, 14.3.2014, A. Benítez & Y. González (H-UTPL YG-0199).

The thallus of *C. macilenta* is characterized its 5–40 × 0.3–2.5 mm whitish ascyphose podetia with subulate to blunt apices that are swollen below the hymenia, unbranched or sometimes branched (Ahti 2000, Burgaz & Ahti 2009). The thallus surface is mostly covered by abundant farinose-soredia (Ahti 2000, Burgaz & Ahti 2009).

Substances detected by TLC: barbatic acid. There are two major chemotypes recognized, chemotype I with thamnolic acid as major compound, and chemotype II with barbatic acid as major compound.

Rare in tropical lowlands and highest mountains, *C. macilenta* is widespread between 1500–3250 m along the northern Andes, growing on wood, stumps, tree bases, peat bogs, acid rocks, and humous or sandy acid soils (Ahti 2000, Burgaz & Ahti 2009). In Ecuador it has been previously found in Carchi (chemotype II), Galapagos Islands (chemotypes I and II), and Tungurahua (chemotype II) (Ahti 2000, Yánez-Ayabaca et al. 2013). Our specimen (chemotype II) represents a first record for Azuay province.

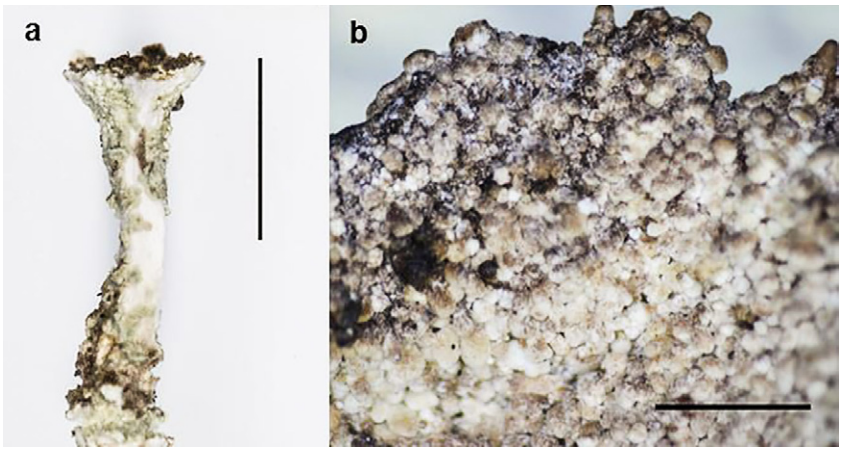

Figure 4. a. ***Cladonia melanopoda.*** Small squamules on surface of podetium. Scale bar = 2 mm. b. ***Cladonia merochlorophaea.*** Phyllidia and schizidia inside scyphi. Scale bar = 2 mm.

Cladonia melanopoda** Ahti, Symb. Bot. Upsal. 32(1): 7. 1997. Fig. 4a

Podetia 45–60 × 0.5–1 mm, slender, unbranched to slightly branched, brownish to blackish at the base. The podetial surface either totally decorticated or with areolate schizidia or small squamules. Scyphi 1–4 mm wide, always with central proliferations in 5–7 tiers.

Substances detected by TLC: fumarprotocetraric acid and traces of quaesitic acid.

Specimens examined—**ECUADOR**, **Loja**. **Saraguro:** Loma del Oro, 3°40′52″S 79°14′24″W, 3245 m, páramo, 19.8.2010, A. Benítez, Y. González & M. Prieto (H-UTPL YG-0019, H-UTPL YG-0020, H-UTPL YG-0021).

Previously found at high elevations of the Andean range in Argentina, Bolivia, and Peru on soil in páramo and timberline vegetation at 1300–4000 m (Ahti 2000), *C. melanopoda* is reported here for the first time in Ecuador from one páramo in Loja province.

Our specimens are very close to those described from the Neotropical region.

Cladonia merochlorophaea** Asahina, J. Jap. Bot. 16: 713. 1940. Fig. 4b

Podetia 10–30 × 1–2 mm, scyphose with 2–6 mm wide scyphi, sometimes simple or frequently with proliferations from margins and the old bases strongly blackish. The surface is usually verruculose with wide bare spaces

and macrosquamules. Inside scyphi there are phyllidia and schizidia often brownish. The scyphal margin may produce pyriform pycnidia.

Substances detected by TLC: merochlorophaeic and fumarprotocetraric acids.

Specimens examined—**ECUADOR**, **Azuay**. **Cuenca:** Parque Nacional El Cajas, 2°46′60″S 79°13′31″W, 4007 m, páramo, 22.2.2014, A. Benítez & Y. González (H-UTPL YG-0151); 2°47′38″S 79°12′10″W, 3895 m, 25.3.2014 (H-UTPL YG-0155); 2°47′36″S 79°12′10″W, 3895 m (H-UTPL YG-0158); 2°46′47″S 79°12′21″W, 3789 m, 13.3.2014 (H-UTPL YG-0162); 2°46′46″S 79°12′19″W, 3790 m, 14.3.2014 (H-UTPL YG-0290).

A subcosmopolitan species found from arctic to temperate regions in Antarctic, Australasia, Eurasia, North America, and southern South America, *C. merochlorophaea* is found In the Neotropical region in Bolivia, Brazil, Peru, and Venezuela (Ahti 2000, pers. comm.) usually growing on acid humus, peat, and wood (Stenroos et al. 1992, Ahti 2000, Burgaz & Ahti 2009). Our collections constitute the first reports for the species in Ecuador, where it was being locally common in Azuay province (in El Cajas páramo).

Our specimens are similar in morphology, chemistry, and ecology to that described for the Neotropical and temperate regions (Ahti 2000).

Cladonia pyxidata* (L.) Hoffm., Deutschl. Fl. 2: 121. 1796. Fig. 5

Primary thallus persistent, squamules 1–3 × 2–3 mm. Scyphose podetia 4–12 mm tall, greenish gray to dark brown, stalks 1–1.5 mm diam., scyphi 0.8–4.5 mm diam., usually simple or sometimes proliferating from margins. Podetia surface corticated, often continuous but can be areolate or cracked and usually decorticated above. Inside of scyphi it presents schizidia, phyllidia, microsquamules, and flat granules, these latter usually larger.

Substances detected by TLC: fumarprotocetraric and homosekikaic acids (chemotype II).

Specimens examined—**ECUADOR**, **Azuay**. **Cuenca:** Parque Nacional El Cajas, 2°47′37″S 79°12′09″W, 3889 m, páramo, 25.3.2014, A. Benítez & Y. González (H-UTPL YG-0168); 2°46′47″S 79°12′21″W, 3791 m, 13.3.2014 (H-UTPL YG-0164 and H-UTPL YG-0167).

Distributed throughout Africa, Asia, Australia, Europe, North America, and New Zealand (Smith et al. 2009), in the Neotropical region *C. pyxidata* has been previously found in Argentina, Brazil, Colombia, Dominican Republic, El Salvador, Galapagos Islands, Haiti, Honduras, Guatemala, Jamaica, Peru, Uruguay, and Venezuela, growing on acid substrates in bare and humous soils, mossy rocks, and rarely on dead wood (Ahti 2000, pers. comm., Burgaz & Ahti 2009, Yánez-Ayabaca et al. 2013). Our collection from Azuay

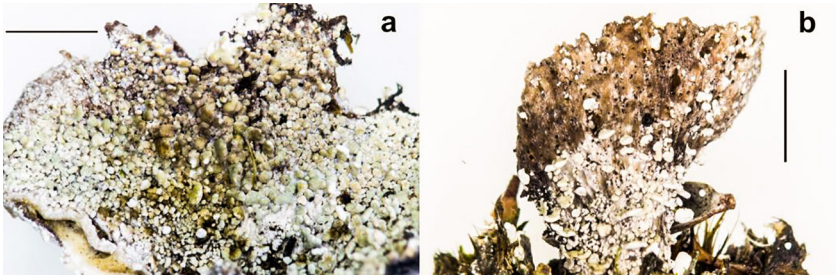

Figure 5. ***Cladonia pyxidata***. a. Phyllidia, schizidia, microsquamules, and flat granules inside scyphi. b. Decorticate podetia surface. Scale bars = 3 mm.

province (in El Cajas páramo) represents the first record of *C. pyxidata* for mainland Ecuador. Chemotype II is fairly rare and has previously been noted only for Guatemala and Honduras (Ahti 2000).

The Ecuadorian material is similar in morphology and ecology to those described for the Neotropical region (Ahti 2000, Burgaz & Ahti 2009, Yánez-Ayabaca et al. 2013) but in Ecuadorian samples the scyphi are wider (≤4 mm).

Cladonia squamosa (Scop.) Hoffm., Deutschl. Fl. 2: 125. 1796.

Substances detected by TLC: squamatic acid (chemotype I), thamnolic and barbatic acids (chemotype II).

Specimens examined—**ECUADOR**, **Loja**. **Saraguro:** Loma del Oro, 3°40′52″S 79°14′24″W, 3245 m, páramo, 7.7.2010, A. Benítez, Y. González & M. Prieto (H-UTPL YG-0017); **Loja:** Parque Nacional Podocarpus, Cajanuma, 4°06′59″S 79°09′41″W, 3337 m, páramo, 13.7.2010, A. Benítez, Y. González & M. Prieto (H-UTPL YG-0066); **Azuay**. **Cuenca:** Parque Nacional El Cajas, 2°47′38″S 79°12′09″W, 3885 m, páramo, 25.3.2014, A. Benítez & Y. González (H-UTPL YG-0193); 2°47′37″S 79°12′09″W, 3891 m, 26.3.2014 (H-UTPL YG-0194); 2°47′39″S 79°12′09″W, 3894 m, 26.3.2014 (H-UTPL YG-0195); 2°47′38″S 79°12′09″W, 3886 m, 25.3.2014 (H-UTPL YG-0197); 2°46′47″S 79°12′19″W, 3782 m, 25.3.2014 (H-UTPL YG-0198); 2°46′37″S 79°12′09″W, 3890 m, 25.3.2014 (H-UTPL YG-0202); 2°47′37″S 79°12′09″W, 3889 m, 25.3.2014 (H-UTPL YG-0203); 2°47′37″S 79°12′09″W, 3889 m, 25.3.2014 (H-UTPL YG-0204); 2°46′46″S 79°12′20″W, 3733 m, 13.3.2014 (H-UTPL YG-0207); 2°47′08″S 79°13′32″W, 4030 m, 9.2.2014 (H-UTPL YG-0209); 2°47′37″S 79°12′04″W, 3889 m, 25.3.2014, (H-UTPL YG-0210); 2°47′00″S 79°13′31″W, 4018 m, 22.2.2014 (H-UTPL YG-0211); 2°47′38″S 79°12′09″W, 3880 m, 25.3.2014 (H-UTPL YG-0212); 2°47′37″S 79°12′10″W, 3886 m, 25.3.2014 (H-UTPL YG-0213); 2°46′47″S 79°12′19″W, 3782 m, 14.3.2014 (H-UTPL

YG-0214); 2°47′08″S 79°13′32″W, 4029 m, 9.2.2014 (H-UTPL YG-0215); 2°47′03″S 79°13′32″W, 4006 m, 16.2.2014 (H-UTPL YG-0221); 2°47′38″S 79°12′10″W, 3891 m, 25.3.2014 (H-UTPL YG-0222); 2°47′38″S 79°12′09″W, 3883 m, 25.3.2014 (H-UTPL YG-0236); 2°46′47″S 79°12′21″W, 3788 m, 13.3.2014 (H-UTPL YG-0258).

In *Cladonia squamosa,* the podetia are 30–140 × 0.5–5 mm, greenish gray to strongly brown, not black at the base, unbranched or irregularly branched, with usually dilated axils and perforated apex (Ahti 2000, Burgaz & Ahti 2009). The thallus surface is never sorediate, but mostly or totally decorticated and densely covered with crenulate or laciniate 1–8 mm tall squamules and granules (Ahti 2000).

Widespread in temperate and cooler regions in both Hemispheres, also along the Andes, from Mexico to Chile, and Argentina at 1000–4500 m altitudes, *C. squamosa* is also present in southeast Brazil down to 700 m. It grows in cloud forests and moist páramos, on rocks and acidic and humous soils or wood (Ahti 2000, Burgaz & Ahti 2009). In Ecuador, the species has been previously found in Azuay (chemotype I), Carchi (chemotype I), Pastaza (chemotype II), and Zamora-Chinchipe (chemotype II) provinces (Arvidsson 1991, Ahti 2000, Nöske & Sipman 2004). Our collections represent the first records of chemotype II specimens from Azuay and Loja provinces and the first record of chemotype I for Azuay province.

Cladonia subreticulata** Ahti, Acta Bot. Fenn. 10: 168. 1973. Fig. 6a

Podetial surface compact and slightly arachnoid, usually forming well-developed cushions. Podetia 30–50 × 3.5–4.5 mm, thick, yellow to grayish yellow, with very irregular branching, open apices and axils, and perforated podetial wall.

Substances detected by TLC: usnic acid (chemotype III).

Specimens examined—**ECUADOR**, **Loja**. **Saraguro:** Loma del Oro, 3°40′52″S 79°14′24″ W, 3245 m, páramo, 19.8.2010, A. Benítez, Y. González & M. Prieto (H-UTPL YG-0023 and H-UTPL YG-0024).

Previously reported from South America in Brazil, Guyana, Peru, and Venezuela at high elevations in woodlands and cloud forests on sandy soils and rock outcrops (Ahti 2000, Ahti & Sipman 2013), *C. subreticulata* was found for the first time in Ecuador, where it was very rare found growing on relatively bare soils in Loma del Oro páramo in Loja province.

Our specimens, which morphologically, ecologically, and chemically resemble those described for the Neotropic Region (Ahti 2000), differ in having smaller (≤5 cm) podetia.

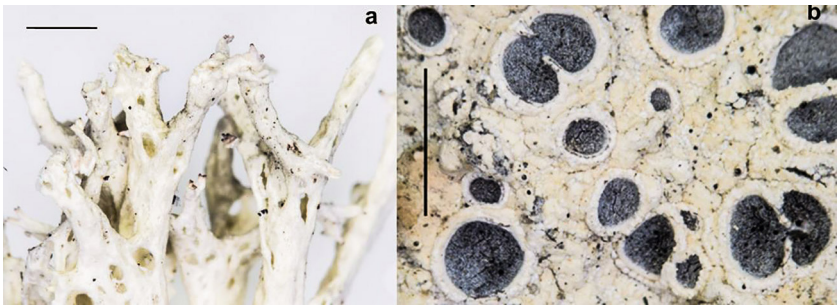

Figure 6. a. ***Cladonia subreticulata.*** Branching of podetia. Scale bar = 3 mm.
b. ***Diploschistes diacapsis.*** Apothecia. Scale bar: 3 mm.

Dibaeis columbiana (Vain.) Kalb & Gierl, Herzogia 9: 621. 1993.

Specimen examined—**ECUADOR**, **Loja**. **Espíndola:** Jimbura, 4°42′37″S 79°25′46″W, 3450 m, páramo, 8.7.2010, A. Benítez, Y. González & M. Prieto (H-UTPL YG-0088).

Diabaeis columbiana is characterized by a densely granular crustose thallus with 0.2 mm wide pale gray granules, 2–11 mm tall podetia with convex pink apothecia, and lacking schizidia or soredia (Sipman 1997).

A terricolous species found in Bolivia, Colombia, Costa Rica, Ecuador, and Venezuela (Marcano et al. 1996, Sipman 1999, Flakus & Wilk 2006), in Ecuador *D. columbiana* was previously found on subalpine dwarf-forest and páramo in Zamora-Chinchipe (Nöske & Sipman 2004). Our collection is the first record for Loja province, where it is rare.

Diploschistes diacapsis** (Ach.) Lumbsch, Lichenologist 20: 20. 1988. Fig. 6b

Thallus verrucose and areolate, upper surface whitish to whitish-gray, slightly to abundantly pruinose; apothecia urceolate, 0.5–2.5(–4) mm diam. black or pruinose gray; ascospores 4–8 per ascus.

Specimens examined—**ECUADOR**, **Loja**. **Saraguro:** Loma del Oro, 3°40′52″S 79°14′24″W, 3245 m, páramo, 19.8.2010, A. Benítez, Y. González & M. Prieto (H-UTPL YG-0034); **Azuay**. **Cuenca:** Parque Nacional El Cajas, 2°46′53″S 79°13′21″W, 3930 m, páramo, 27.7.2010 (H-UTPL YG-0058); 2°46′46″S 79°12′21″W, 3790 m, 13.3.2014, A. Benítez & Y. González (H-UTPL YG-0302).

Diploschistes diacapsis is identified by the K+ yellow reaction of the thallus due to the presence of diploschistesic acid as major constituent (Rivas Plata et al. 2010); the PD–, C+ red and KC+ red chemistry is due to lecanoric and diploschistesic acids.

Found in Africa, Asia, Australia, Europe, North, and South America (Lumbsch 1989), *D. diacapsis* has been reported from South America from páramo ecosystems in Chile, Costa Rica, and Peru (Lumbsch 1989, Galloway & Quilhot 1998, Sipman 1999). Our collections constitute the first records from Ecuador, where it was found growing in two different páramos in Azuay and Loja provinces.

Our specimens closely resemble those described in the Holarctic zone (Lumbsch 1989) except for its larger (≤4 mm) apothecia.

Normandina pulchella (Borrer) Nyl., Ann. Sci. Nat., Bot., sér. 4, 15: 382. 1861.

Specimens examined—**ECUADOR**, **Loja**. **Saraguro:** Loma del Oro, 3°40′52″S 79°14′24″W, 3245 m, páramo, 13.8.2010, A. Benítez, Y. González & M. Prieto (H-UTPL YG-0107); **Espíndola:** Jimbura, 4°42′37″S 79°25′46″W, 3450 m, páramo, 8.7.2010, A. Benítez, Y. González & M. Prieto (H-UTPL YG-0108).

Normandina pulchella is characterized by its very thin 0.7–2.5 mm tall scattered to crowded green to slightly bluish green squamules with sharply raised margins. Soralia are often present on lobe surface and margins. The lower squamule surfaces are whitish and slightly felted with numerous hyphae (Smith et al. 2009).

A frequent cosmopolitan species (Smith et al. 2009), in the Neotropical region *N. pulchella* is found in Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Ecuador, Guyana, Peru, Uruguay, and Venezuela (Calvelo & Liberatore 2002, Flakus & Wilk 2006, Sipman 1999). It grows on mosses, other lichens, bark, and rocks in habitats with high air humidity (Nash et al. 2004). In Ecuador the species was previously found in Galapagos Islands and Zamora-Chinchipe (Arvidsson 1991, Elix et al. 1998, Davey 1999, Nöske 2004, Nöske & Sipman 2004, Mandl 2007). Our collections represent the first records from Loja province, where it was found growing on bryophytes.

Phyllobaeis imbricata (Hook.) Kalb & Gierl, Herzogia 9: 610. 1993.

Specimens examined—**ECUADOR**, **Loja**. **Saraguro:** Loma del Oro, 3°40′52″S 79°14′24″W, 3245 m, páramo, 7.7.2010, A. Benítez, Y. González & M. Prieto (H-UTPL YG-0029, H-UTPL YG-0030 and H-UTPL YG-0031); **Loja:** Parque Nacional Podocarpus, Cajanuma, 4°06′59″S 79°09′41″W, 3337 m, páramo, 29.6.2010, A. Benítez, Y. González & M. Prieto (H-UTPL YG-0073 and H-UTPL YG-0074).

Phyllobaeis imbricata is distinguished by its squamulose primary thallus with long deeply lobed squamules, cylindric podetia, and pink terminal apothecia.

A high-elevation Neotropical species in Bolivia, Brazil, Colombia, Costa Rica, Ecuador, and Venezuela (Gierl et al. 1993, Sipman 1999, Umaña-Tenorio et al. 2002, Flakus & Wilk 2006), in Ecuador, *P. imbricata* was previously found

in Zamora-Chinchipe on subalpine dwarf-forest and páramo (Nöske & Sipman 2004). Our specimens represent the first records for Loja province where they were collected from two different páramos.

Stereocaulon obesum Th. Fr., Stereoc. Piloph. Comm.: 28. 1857.

Spot test: K+ yellow, PD– or slowly yellow. Substances detected by TLC: atranorin and lobaric acid.

Specimen examined—**ECUADOR**, **Azuay**. **Cuenca**: Parque Nacional El Cajas, 2°46′53″S 79°13′21″W, 3930 m, páramo, 27.7.2010, A. Benítez, Y. González & M. Prieto (H-UTPL YG-0056).

Stereocaulon obesum is characterized its abundant and small upright and thin pseudopodetia, unbranched at the base, but branched toward the apex, bicolored peltate phyllocladia, and inconspicuous or irregular translucent cephalodia (Rincón-Espitia & Mateus 2013).

Restricted to the Neotropics at 1700–4000 m altitudes in Costa Rica, Ecuador, Guatemala, and Panamá (Sipman 2002b), in Ecuador *S. obesum* was previously found in Pichincha (Arvidson 1991). Our collection constitutes the first record for Azuay province.

Stereocaulon ramulosum Raeusch., Nomencl. Bot., Ed. 3: 328. 1797.

Spot test: K+ yellow, PD+ slowly yellow. Substances detected by TLC: atranorin and perlatolic acid.

Specimen examined—**ECUADOR**, **Loja**. **Saraguro:** Loma del Oro, 3°40′52″S 79°14′24″W, 3245 m, páramo, 7.7.2010, A. Benítez, Y. González & M. Prieto (H-UTPL YG-0039).

Stereocaulon ramulosum is characterized by its >20 mm tall pseudopodetia unbranched at the base with a few branches towards the apex and with few more or less branched cylindrical phyllocladia, abundant large convex reddish brown to black apothecia, and globose wrinkled cephalodia (Sipman 2002b, Rincón-Espitia & Mateus 2013).

Widespread in the Southern Hemisphere and in Neotropical mountains at 1000–4500 m altitudes in Brazil, Bolivia, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, Mexico, Peru, and Venezuela (Sipman 2002b), in Ecuador *S. ramulosum* was previously recorded from Chimborazo, Loja, Pastaza, Pichincha, and Zamora-Chinchipe provinces (Mitten 1851, Leighton 1866, Müller 1879, Zahlbruckner 1905, 1907, Nöske & Sipman 2004). Our collection represents the first record for Loja province.

Stereocaulon tomentosum Fr., Sched. Crit. Lich. Suec. Exs. 3: 20. 1825.

Spot test: PD+ orange, K+ orange. Substance detected by TLC: atranorin and stictic acid, corresponding to the type variety.

Specimens examined—**ECUADOR**, **Azuay**. **Cuenca:** Parque Nacional El Cajas, 2°46′53″S 79°13′21″W, 3930 m, páramo, 27.7.2010, A. Benítez, Y. González & M. Prieto (H-UTPL YG-0061); 2°47′03″S 79°13′30″W, 4009 m, páramo, 15.2.2014, A. Benítez & Y. González (H-UTPL YG-0308).

Stereocaulon tomentosum is characterized by an erect to prostrate thallus, with lobed, squamulose, warty, or flattened phyllocladia (Brodo et al. 2001), pseudopodetia covered with a thick felt layer (white tomentum) that also covers the cephalodia, and numerous small (<1 mm diam) apothecia sitting on short subapical branchlets and with spherical cephalodia (Sipman 2002b).

A subcosmopolitan species widespread in the Neotropics at 2300–4400 m altitudes in Bolivia, Colombia, Costa Rica, Dominican Republic, Ecuador, Mexico, Peru, and Venezuela (Sipman 2002b), in Ecuador *S. tomentosum* was previously found in Chimborazo, Pichincha, and Zamora-Chinchipe (Leighton 1866, Arvidsson 1991, Nöske & Sipman 2004). Our collections are the first records for Azuay province.

Thamnolia vermicularis (Sw.) Schaer., Enum. Crit. Lich. Eur.: 243. 1850.

Spot test: PD+ yellow-orange, K+yellow-orange, UV–, with thamnolic acid.

Specimens examined—**ECUADOR**, **Loja**. **Loja:** Parque Nacional Podocarpus, Cajanuma, 4°06′59″S 79°09′41″W, 3337 m, páramo, 29.6.2010, A. Benítez, Y. González & M. Prieto (H-UTPL YG-0077); **Espíndola:** Jimbura, 4°42′37″S 79°25′46″W, 3450 m, páramo, 8.7.2010, A. Benítez, Y. González & M. Prieto (H-UTPL YG-0109); **Azuay**. **Cuenca:** Parque Nacional El Cajas, 2°46′53″S 79°13′21″W, 3930 m, páramo, 27.7.2010, A. Benítez, Y. González & M. Prieto; 2°47′03″S 79°13′30″W, 4006 m, páramo, 15.2.2014, A. Benítez & Y. González (H-UTPL YG-0306); 2°47′36″S 79°12′09″W, 3890 m, 26.3.2014 (H-UTPL YG-0307).

Thamnolia vermicularis is characterizes as a fruticose species with a 20–70 × 1–2.5 mm decumbent to erect thallus with unbranched to slightly branched hollow white to cream white stalks that are pointed at the tips, and which lacks soredia, isidia, and fruiting bodies (Brodo et al. 2001).

The molecular study of *Thamnolia* Platt & Spatafora (2000) detected enough genetic differences separating *T. vermicularis* (containing thamnolic acid) and *T. subuliformis* (containing squamatic and baeomycesic acids and with a UV+Y cortex and a UV+ blue-white medulla) to support them as independent species.

Widespread in Australia, Asia, Europe, New Zealand, and North America (Smith et al. 2009), *T. vermicularis* has been recorded at 2800–4550 m altitudes in the Neotropical region from Argentina, Bolivia, Chile, Colombia, Costa Rica, Ecuador, Peru, and Venezuela (Soukup 1965, Sipman 1999, Calvelo & Liberatore 2002, Flakus & Wilk 2006, Villagra et al. 2009). In Ecuador, it was previously found in Chimborazo, Cotopaxi, and Pichincha

provinces (Zahlbruckner 1905, 1907; Arvidsson, 1991, Sklenář et al. 2010). Our collections constitute first records of *T. vermicularis* for Azuay and Loja provinces.

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